

Notice

Notice: 0160

Penetrations

Issuing Authority: John McNeel

Endorsed by: Carolyn Mangeng , ADTS

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Summary:

This Notice (1) briefly describes two penetration incidents that occurred in 2003, along with their evaluations and conclusions; (2) re-emphasizes the requirements of LIR-402-880-02 to provide clarification and guidance when conducting operations involving penetrations; and (3) requires that ground-penetrating radar (GPR) *not be* the *only* method to detect hidden hazards.

Application:

To perform penetration operations safely, the requirements of [LIR 402-880-02](#), “Penetrations,” must be implemented. **These requirements must be implemented for programmatic as well as facility work.** Refer to the LIR for a complete list of requirements for penetration operations.

This Notice clarifies some of the LIR requirements. For Class-2 penetrations (deeper than 1.5 in. or all the way through a solid material),

- workers must review drawings of the area, if they exist, to determine whether hidden hazards are present in the penetration area.
- If known electrical or other utility lines are present in the area, they must be de-energized and locked/tagged out.
- If hidden hazards are suspected, the work must be relocated if possible. If it is not possible to relocate the work, non-destructive testing must be used to determine whether hidden hazards exist. **GPR must not be relied upon as the only method of detecting hidden hazards.**

Implementing these basic and other requirements contained in the LIR are essential for ensuring that workers are protected.

Justification:

The following occurrences at the Laboratory involved penetration implementation issues:

Incident 1: In June 2003 (Occurrence Report ALO-LA-LANL-ADOADMIN-2003-0002), a pipefitter penetrated an energized, 120-V AC electrical conduit while drilling into a concrete floor. The pipefitter had been tasked to install a quarter-inch copper line from the building potable water supply to a refrigerator on the second floor. He planned to drill through the concrete floor to route the line from the second floor to a potable water pipe below on the first floor. He had drilled into the floor approximately two inches when he encountered an obstruction. As he was pulling out the drill, other workers observed a spark and realized the pipefitter had penetrated an electrical conduit.

No personnel were injured.

Incident 2: In September 2003 (Occurrence Report ALO-AL-LANL-ACCCOMPLEX-2003-0003), a subcontractor severed an energized, 120-V AC conduit while cutting through a concrete slab at TA-53. The subcontractor had been tasked with removing a 2-foot by 12-foot section of concrete flooring to prepare for the installation of a motor control center. The conduit was severed with a gas saw and was not identified until cleanup of the area was taking place, and a worker plugged in a shop vacuum cleaner and noted that no power was present. **No personnel were injured.**

This Notice summarizes the issues associated with these occurrences. For more detailed information, contact the Occurrence Investigation Group (PS-7, 665-0033).

Occurrence 1:

- The drawings for the area were not reviewed when the work was planned because review of the drawings for a previous job showed that the drawings were old (1951) and difficult to read.
- The energy sources for the area were not de-energized prior to the start of the work even though an electrical conduit, located in the vicinity, provided power for a receptacle and emergency lighting located on the wall above and to the right of the penetration point. It was assumed that the conduit ran underneath the wall as is common industry practice; however, the conduit ran along the flooring in the area selected for the penetration.
- Ground-penetrating radar (GPR) was used to evaluate the work area and to detect any anomalies or readings. The GPR crew noted an area, which they called a “buffer zone,” in which they were unable to detect any anomalies or readings due to the limitations of their equipment.
- The penetration was in the “buffer zone.” The term “buffer zone” was misunderstood by the worker, who assumed it meant that the area was free of hidden hazards.
- The worker wore PPE consisting of dielectric gloves (rated for 1000 V) with liners, leather gloves, and rubber boots. The worker also used a double-insulated drill with a masonry bit and GFCI protection to drill the hole.

Occurrence 2:

- A 120-V receptacle was located about one foot away from the flooring to be removed, and although conduit from the receptacle dropped and entered the flooring, this energy source was not de-energized.
- The GPR of the proposed cut area did not show that the conduit angled towards the cut area and entered into the corner of the cut area.
- A drawing of the area was reviewed prior to conducting the work. However, further research of secondary utilities drawings after the incident revealed another drawing that indicated that an electrical line was present in the flooring.
- The worker wore PPE consisting of rubber boots and rubber gloves rated for 17 kV and used a rubber mat.

Conclusions

- In both cases, the electrical energy that was obviously present in the area of the penetrations should have been de-energized and locked/tagged out.
- GPR should not have been relied on as the only means to determine if other unknown utilities existed in the area, or if the known electrical energy entered the penetration area.

- In Occurrence 1, GPR was incapable of determining if a hazard existed in the penetration area due to equipment limitations. In this case, the penetration should have been relocated or another non-destructive detection technique pursued.
- Because uncertainty existed due to the age of the facility, the lack of up-to-date drawings, and/or indeterminate non-destructive testing results, electrical and other energy in the area of the penetration (room, floor, or even building) should have been de-energized to ensure that workers were protected.
- Fortunately, in both cases, workers were wearing PPE that protected them from the unknown electrical hazard.

Resulting Action: The GPR crew has revised their procedure to change the term “Buffer Zone” to “Unknown Zone.” Unknown zones are areas within the GPR scan areas that cannot be reliably scanned by the GPR equipment due to equipment and building restrictions.

Instructions:

[LIR 402-880-02](#), “Penetrations,” establishes the requirements for evaluating and controlling the hazards associated with penetration operations. These requirements exist to protect the worker and **must be implemented for programmatic as well as facility work.**

The LIR provides requirements for two classes of penetrations:

- Class-1 penetrations are penetrations that are made into hollow walls, hollow ceilings, or hollow floors, or penetrations into solid material to a depth of 1.5 in. or less.
- Class-2 penetrations are those that are deeper than 1.5 in. or are all the way through a solid material.

For each type of penetration, the LIR provides requirements that must be implemented to evaluate and control potential hazards. The requirements and emphasis contained in this Notice focus on Class-2 penetrations because both of the incidents involved penetrations all the way through a solid material.

The LIR requires that the hazard evaluation for Class-2 penetrations must include the following actions:

- Review historical records, engineering plans, and drawings for the area/location of the planned penetration.
- Clarification:** If these drawings exist, they must be reviewed before each penetration operation. If the records, plans, or drawings are illegible or incomplete, the worker must request other records, plans, or drawings.
- Consult with the facility manager, customer/requestor, or other personnel who may have knowledge of the area to assist in identifying possible hidden hazards.
 - Visually inspect the proposed location of the penetration for any hidden utilities by checking behind walls, into false ceilings, and under subflooring systems for any evidence of utility runs that lead to or from power sources or valves, and conduits exiting through floor slabs, walls, and roofs.

The LIR also requires the following controls that must be implemented for Class-2 penetrations:

(1) de-energizing and locking/tagging out all circuits and other energy sources (such as gas lines) in the room, building, or area if known electrical or other utility lines are present in the solid material and if the penetration site cannot be changed to a safer location;

Clarification: If, for example, the penetration is into a concrete floor and the floor is known to contain electrical or other utility lines, the energy sources in the floor must be de-energized and locked/tagged out EVEN IF there is evidence to suggest that those utility lines are not in the area of the penetration.

(2) relocating the work if hidden hazards are suspected;

(3) if the work cannot be relocated, using non-destructive testing devices (GPR, x-ray, magnetic, induction, conductive, or other devices and methods) to determine whether additional hazards exist;

Clarification: GPR should not be relied on as the *only* method of detecting hidden hazards. In some cases, due to equipment and building limitations, GPR is ineffective. Typically, the equipment cannot produce reliable scan results within 6 inches of any structure such as a wall or ceiling.

(4) using electrical tools that are equipped with GFCI protection or electric hand tools that are double-insulated;

(5) wearing dielectric rubber outer boots over required foot protection if the process requires the use of water or other coolants; wearing the correct classification of dielectric gloves, approved protective outer leather gloves in conjunction with the dielectric gloves, nonconductive safety glasses, and a face shield. If electrical hazards exist or may exist and the voltage is unknown, Class-2 protection must be worn.

Clarification: PPE can fail and must not be relied upon as the only means of protection for the worker.

(6) using masonry or wood bits whenever possible;

(7) where possible, using short drill bits or marking equipment to limit the depth of the penetration; and

(8) completing a penetration permit ([Attachment A, LIR 402-880-02](#)).

Ensure that GPR is not the only method implemented to detect hidden hazards.

Contact: Theresa Cull, HSR-5, may be reached at 7-7586 or at tcull@lanl.gov for questions or information pertaining to this notice.

This Notice will remain in effect until LIR 402-880-02 is revised, or until one year from date of issuance, whichever occurs first.